Research Note

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

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RESULTS OF DIRECT SEEDING OF WESTERN REDCEDAR AND ENGELMANN SPRUCE IN THE NORTHERN ROCKY MOUNTAIN REGION 1/

Direct seeding of western redcedar and Engelmann spruce without protecting the seeds from birds and rodents has been moderately successful in preliminary trials on certain sites in the northern Rocky Mountain region. These tests, made by the Northern Rocky Mountain Forest and Range Experiment Station, indicate that direct seeding may become a satisfactory and relatively cheap method of obtaining stands of western redcedar and Engelmann spruce on selected areas.

Because of its commercial importance and comparative freedom from enemies, redcedar is a desirable species for use in the reforestation program of the western white pine type, but it has not been used to any extent because of difficulties in raising nursery stock and getting adequate establishment in the field. Engelmann spruce has been planted more extensively in the northern Rocky Mountain region, especially on areas outside the zone of blister rust protection, but costs for stock have been higher than for other species commonly planted. On less accessible areas at higher elevations, where it may be desirable to artificially establish spruce, direct seeding should have several advantages over planting if practical application gives results similar to those obtained on the better sites in the trials described below.

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METHODS AND RESULTS

Sowings were made on 15 areas to disclose which sites are suitable for artificial establishment of these species by direct seeding. A second objective of the tests, as stated by Schopmeyer2/, who started the study, was "to test the hypothesis that the small seeds of these species are unattractive to the rodents of this region."

Western Redcedar

Western redcedar seeds (325,000 per pound) were sown in the fall at eleven different locations on the Coeur d'Alene, Kaniksu, and St. Joe National Forests. First-year results for five of these eleven tests have been reported previously.2/

Areas selected for seeding of western redcedar are as follows:

A. Fresh broadcast burn on north-facing slope with silt loam soil. Elevation 4,000 feet. Upper Sands Creek, Deception Creek Experimental Forest, Idaho.

B. Fresh broadcast burn on flat ground with slightly podsolized sandy loam soil. Elevation 3,600 feet. Kalispell Creek, Kaniksu National Forest, Washington.

C. Four-year-old broadcast burn on north-facing slope with silt loam soil lightly covered with a mixture of herbaceous and shrubby species at the time of sowing. Elevation 3,200 feet. Lower Sands Creek, Deception Creek Experimental Forest, Idaho.

D. North-facing slope under 30-year-old sapling stand of western white pine. Soil is silt loam with much rock. Elevation 2,900 feet. Ames Creek, Deception Creek Experimental Forest, Idaho.

E. Northwest-facing slope covered with dense growth of ceanothus and willow brush. Soil is silt loam. Elevation 2,600 feet. Benton Creek, Priest River Experimental Forest, Idaho.

2/ Schopmeyer, C. S. The use of western redcedar in reforestation by direct seeding. Research Note no. 5. Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana. March 1940.

F. Selectively logged area on gentle east-facing slope, cutover in 1936 leaving a shelterwood of small white pine seed trees; logging slash piled and burned. Soil is silt loam with few rocks. Elevation 3,100 feet. Near Frog Creek, upper North Fork Coeur d'Alene River, Coeur d'Alene National Forest, Idaho.

G. Fresh broadcast burn on 30 to 40 percent north-facing slope. Sandy loam soil with frequent outcrops of granite and a hardpan about two or three feet below the surface. Elevation 4,400 feet. Kalispell Creek, Kaniksu National Forest, Washington.

H. Logged area on moderately steep north-facing slope cutover in 1938-1939 leaving seed trees and rather open hemlock-grand fir overstory. Soil is silt loam with much gravel and large rock; duff and surface debris are very thick having a depth of a foot or more in places. Elevation 3,400 feet. Iron Creek, Coeur d'Alene National Forest, Idaho.

I. Same site as H above except is west-facing slope and has heavier overstory of white pine seed trees, hemlock, and grand fir.

J. Same site as H above except is east-facing slope with overstory similar to that of I above.

K. North-facing slope with dense cover of willow and ceanothus brush which came in after logging and fires of about 25 years ago. Soil is fine sandy loam with few rocks. Elevation 3,600 feet. Near Beal's Butte, St. Joe National Forest, Idaho.

On each of these sites nine sample plots were established at intervals of approximately 200 feet using a three-by-three arrangement. Each plot contained 25 seed spots arranged in five rows of five spots each, with rows, as well as spots within rows, spaced eight feet apart. This spacing had to be modified in some cases to find places where a spot could be made in mineral soil. From 25 to 50 seeds were sown in each spot and covered with mineral soil to a depth of approximately one-eighth inch. All sowing was done during October.

Germination and survival data, in terms of the percentage of the total number of spots sown having one or more seedlings per spot, are summarized in table 1.

Table 1.--Germination and survival of western redcedar, in percentage of total number of spots sown having one or more live seedlings per spot, in 11 direct seeding tests 1/

Seeding test	Description of test area	Year sown	Germination	First-year survival	Second-year survival	Third-year survival
			Percent	Percent	Percent	Percent
A	Fresh burn on north slope	1938	98	92	80	77
B	Fresh burn on flat	1938	52	33	23	22
C	Four-year-old burn on north slope	1938	96	79	43	35
D	Under sapling stand of white pine on north slope	1938	99	84	68	58
E	Brushfield of ceanothus and willow on northwest slope	1938	88	0		
F	Under white pine shelterwood on east slope	1939	92	57	37	
G	Fresh burn on north slope	1939	60	40	37	
H	Under cutover hemlock overstory on north slope	1940	100	100		
I	Under cutover hemlock overstory on west slope	1940	99	97		
J	Under cutover hemlock overstory on east slope	1940	97	94		
K	Brushfield of willow and ceanothus on north slope	1940	78	66		

1/ Each test consisted of 225 seed spots.

Table 1 shows that first-year survival of western redcedar on 11 locations was "satisfactory" on ten of them.3/ Failure of brushfield plot E was apparently caused by lack of available surface soil moisture resulting from loss of water by transpiration and evaporation during the dry summer of 1939.4/ A similar brushfield plot, K, was successful two years later, undoubtedly because soil moisture was not critical during the summer of 1941.

Second-year survival of redcedar on six plots was "satisfactory" on five of them. Unsatisfactory stocking of the plot established on a burned flat, site B, was caused by insolation and resultant surface-soil drying.4/ Successful spots on this site were almost invariably located in the shade of stumps and logs.

Redcedar survival at the end of three years was still "satisfactory" on the three plots which had been "satisfactory" the year before. Some loss was caused by erosion, smothering by fallen leaves and bark, trampling by deer, and by early summer insolation.

Stocking on site A, a fresh burn on north-facing slope, was over twice as high at the end of the first and second growing seasons as stocking on site G, also a fresh burn on a north-facing slope but seeded a year later.

Engelmann Spruce

Engelmann spruce seeds (175,000 per pound) were sown on four different areas, as listed below, on the Clearwater, Coeur d'Alene, and Kaniksu National Forests. First and second-year results on two of these have already been reported by Schopmeyer.5,6/

3/ "Satisfactory" survival in the northern Rocky Mountain region requires (a) 200 or more stocked spots or trees per acre if original seeding or planting is 800 or more per acre, or (b) 25 percent or more when original number is less than 800 per acre.

4/ See footnote 2.

5/ Schopmeyer, C. S. Direct seeding in the western white pine type. Applied Forestry Notes no. 90. Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana. May 1939.

6/ Schopmeyer, C. S. Second-year results of direct-seeding experiments in the western white pine type using screens for rodent control. Research Note no. 6. Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana. May 1940.

L. Fresh broadcast burn on north-facing slope with silt loam soil. Elevation 3,800 feet. Sands Creek, Deception Creek Experimental Forest, Idaho.

M. Fresh broadcast burn on north-facing slope with silt loam soil. Elevation 3,500 feet, Solitaire Creek, Coeur d'Alene National Forest, Idaho.

N. Two-year-old broadcast burn on north-facing slope, sparse vegetation mainly of fireweed. Heavy silt loam soil with little rock. Elevation 4,200 feet. Slate Creek, Kaniksu National Forest, Washington.

O. Six-year-old severe burn on north-facing slope near ridge top. Very little vegetation on ground. Soil is gravelly silt loam with scattered granitic rock outcrops, shallow, severely eroded, mixed with considerable gravel (decomposed granite) resulting from weathering of rock outcrops, and of low moisture-holding capacity. Elevation 5,000 feet. Alder Creek, Clearwater National Forest, Idaho.

Engelmann spruce tests on sites L and M consisted of one plot on each area with eight subplots each containing 18 screened alternating with 18 unscreened spots in six-by-six arrangement. Spruce tests on sites N and O consisted of nine sample plots each, spaced and arranged as the cedar plots already described. The spruce plots differed from the redcedar in having not only 25 unscreened spots but also an additional block of 25 spots protected by conical wire screens during the first growing season. In October, 15 to 20 seeds were sown per spot and covered with one-sixteenth to one-eighth inch of soil.

Table 2 summarizes germination and survival data for these four tests of Engelmann spruce.

Table 2.--Germination and survival of Engelmann spruce, in percentage of total number of spots sown having one or more live seedlings per spot, in four direct-seeding tests 1/

Seeding test	Description of test area	Year sown	Rodent protection	Germination	First-year survival	Second-year survival	Third-year survival
				Percent	Percent	Percent	Percent
L	Fresh burn on north slope	1937	Screens	98	94	86	76
			None	95	86	77	73
M	Fresh burn on north slope	1937	Screens	99	98	97	90
			None	94	81	74	68
N	Two-year-old burn on north slope	1940	Screens	90	85		
			None	79	70		
O	Six-year-old severe burn on north slope	1940	Screens	84	23		
			None	70	1		

1/ Tests L and M consisted of 288 seed spots each and tests N and O of 500 spots each.

Table 2 shows that germination of Engelmann spruce was satisfactory on all four screened and unscreened sites. First-year survival, however, was unsatisfactory on site O both with and without screens. Site O is a severe one where spruce can hardly be expected to do well. Two of the screened plots on site O used 6-mesh screens. Under these screens survival was 78 percent while on the other seven plots under 2- and 3-mesh screens survival was only 7 percent, an average for the site of 23 percent. General failure on this rigorous site was caused by insolation, insufficient soil moisture during the early part of the summer, destruction of the seedlings by grasshoppers, and erosion. Under the 6-mesh screens success resulted because the screens provided shade, conserved soil moisture, prevented the entrance of grasshoppers, and acted as mechanical guards against erosion.

Second- and third-year survival of spruce was good on the two similar areas, L and M, with the spots which had been screened the first year showing somewhat better stocking than the unscreened ones.

CONCLUSIONS

Seeds of western redcedar and Engelmann spruce seem unattractive to rodents when covered with a thin layer of soil and therefore can be used in direct seeding without protection from rodents. Although Engelmann spruce seed spots protected by screens gave better stocking than unprotected spots, both were satisfactory with the difference in favor of protection not being great enough to warrant the additional expense of screens. With large-seeded species the chief value of screens is the protection they provide against rodents, but with small-seeded spruce the main value of screens seems to be the shade and the protection from erosion and insects which they provide.

On favorable sites - north slopes with good soil, some shade, but without much vegetation competing for surface soil moisture - spot sowing in the fall of western redcedar and Engelmann spruce seeds without rodent protection gave moderate success on a trial basis. On less favorable sites failure resulted during hot or dry periods when available soil moisture was reduced below the amount required to sustain life. Both redcedar and spruce, but particularly redcedar, grow slowly the first two years, require rather exact site conditions, and are susceptible to death from insufficient surface soil moisture where other faster-growing species may survive. The small seeds and one-year-old seedlings of redcedar and spruce are also particularly subject to loss by washing away of the seeds and plants, covering by eroded debris, and smothering by leaves, bark, duff, and rotted wood.

First-year survival of western redcedar seeded under a shelterwood of hemlock was very good on east, west, and north exposures after the favorable summer of 1941.

First-year failure during the moderately severe summer of 1939 and first-year success during the mild summer of 1941 warn that successful seeding under brushfields with redcedar may be possible only in the more favorable years. Second- and third-year results of this 1941 brushfield test should be noted before practical application of seeding under heavy brush.

These tests have provided some experience in seeding procedure. In sowing both western redcedar and Engelmann spruce care must be taken to place the seed on and cover them lightly with mineral soil. The making of depressions or hollows in the ground surface when constructing spots for seeding should be avoided as these will catch rolling stones, cones, and litter which will smother the young seedlings. Steep slopes, narrow creek bottoms, or gullies are not suitable for seeding with redcedar and spruce as the small seeds and first-year plants are easily washed out by erosion. Several seeds must be sown per spot to allow for nonviable seeds. If several seedlings

survive in one spot, observations have shown that one of them usually acquires dominance and overtops the others in about three years.

Results of these experiments justify small-scale administrative application of similar seeding on favorable redcedar and spruce sites. Seeding on sites not similar to those successfully tested in these trials is not recommended. Further investigations are needed to define the limits of possible successful application.